

HIGH THROUGHPUT PROCESS FOR THE FORMATION OF A REFRACTORY METAL NUCLEATION LAYER

ABSTRACT OF THE DISCLOSURE

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A method for the formation of a refractory metal nucleation layer (e.g., a tungsten nucleation layer) on a semiconductor device substrate that includes first depositing a metallic barrier layer (e.g., a titanium-nitride barrier layer) on the substrate. Next, the metallic barrier layer is exposed to a silicon-containing gas (e.g., monosilane) to form a layer of silicon (e.g., a monolayer of silicon) on the metallic barrier layer. The layer of silicon is then exposed to a refractory metal-containing gas (e.g., WF_6) in a manner such that the refractory metal-containing gas undergoes a reduction reaction with the layer of silicon. The result of this reaction is the formation of a refractory metal layer (e.g., a tungsten metal layer) on the metallic barrier layer. Subsequently, an alternating exposure of the refractory metal layer to the silicon-containing gas and the refractory metal-containing gas is conducted. This alternating exposure deposits additional refractory metal on the refractory metal layer in order to form a refractory metal nucleation layer. Processes according to the present invention employ a relatively high pressure (i.e., between 40 and 300 Torr) during formation of the tungsten nucleation layer. The relatively high pressure facilitates fast reactions and temperature stabilization during formation of the refractory metal nucleation layer and, thus, a high throughput process. In addition, the process can be combined with a conventional tungsten core layer deposition conducted at a relatively high pressure without the need to expend process time cycling between two different deposition pressures, thus providing a high effective throughput.

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SF 1313945 v1